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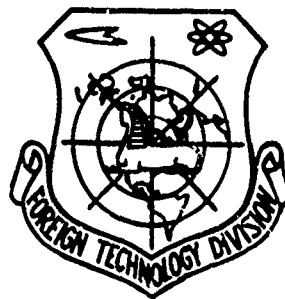
FOREIGN TECHNOLOGY DIVISION



COMPARISON OF DIFFERENT METHODS OF
DETERMINING THE TRANSFER FUNCTIONS
OF BLACK AND WHITE AERIAL FILMS

by

V. Ya. Mikhaylov and Ya. P. Maslenikov



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By: V. Ya. Mikhaylov and Ya. P. Maslenikov

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13. ABSTRACT It is shown that transfer functions were determined by projection printing of the sinusoidal image and contact printing using a sensitometer. Measurements were made of all types of aerial photography films. For comparison the transfer functions for certain Orvo films were measured. It is seen that the curves obtained experimentally are located higher than those obtained by calculation. This divergence is most noticeable at low frequencies. The experimental method of determining the transfer function is preferred.			

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14. KEY WORDS	LINK A		LINK B		LINK C	
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Aerial Photography Photographic Film Photographic Image						

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Block	Italic	Transliteration	Block	Italic	Transliteration
А а	<i>А а</i>	A, a	Р р	<i>Р р</i>	R, r
Б б	<i>Б б</i>	B, b	С с	<i>С с</i>	S, s
В в	<i>В в</i>	V, v	Т т	<i>Т т</i>	T, t
Г г	<i>Г г</i>	G, g	У у	<i>У у</i>	U, u
Д д	<i>Д д</i>	D, d	Ф ф	<i>Ф ф</i>	F, f
Е е	<i>Е е</i>	Ye, ye; E, e*	Х х	<i>Х х</i>	Kh, kh
Ж ж	<i>Ж ж</i>	Zh, zh	Ц ц	<i>Ц ц</i>	Ts, ts
З з	<i>З з</i>	Z, z	Ч ч	<i>Ч ч</i>	Ch, ch
И и	<i>И и</i>	I, i	Ш ш	<i>Ш ш</i>	Sh, sh
Й й	<i>Й й</i>	Y, y	Щ щ	<i>Щ щ</i>	Shch, shch
К к	<i>К к</i>	K, k	Ъ ъ	<i>Ъ ъ</i>	"
Л л	<i>Л л</i>	L, l	Ы ы	<i>Ы ы</i>	Y, y
М м	<i>М м</i>	M, m	Ь ь	<i>Ь ь</i>	'
Н н	<i>Н н</i>	N, n	Э э	<i>Э э</i>	E, e
О о	<i>О о</i>	O, o	Ю ю	<i>Ю ю</i>	Yu, yu
П п	<i>П п</i>	P, p	Я я	<i>Я я</i>	ya, ya

* ye initially, after vowels, and after ъ, ь; e elsewhere.
 When written as ё in Russian, transliterate as yё or ü.
 The use of diacritical marks is preferred, but such marks
 may be omitted when expediency dictates.

COMPARISON OF DIFFERENT METHODS OF DETERMINING THE TRANSFER FUNCTIONS OF BLACK AND WHITE AERIAL FILMS

V. Ya. Mikhaylov and Ya. P. Maslenikov

Previously published works [1-6] have presented the transfer functions of different light-sensitive materials, also including some aerial films. However, with the exception of work [1], the given frequency-contrast characteristics (FCC) are calculated, based on diffusigrams¹ or on the shape of the boundary curve. A Π -shaped optical focusing pattern was used for this. In this work the transfer functions were determined in two ways: by the projection printing of a sinusoidal optical focusing pattern and by the contact printing of a NIKFI [All-Union Scientific Research Institute of Motion Pictures and Photography] test object using a TsS-2 sensitometer. The sinusoidal optical focusing pattern was made with the help of polaroids. An instrument of the type proposed by Khandeberg [Handeberg?] was constructed for this purpose. According to the data of work [1] results with good reproducibility are received using this device, which also confirms our experiences. We built this instrument with certain structural changes which do not violate its principle nature.

¹Translator's note: Unable to verify this term in available sources.

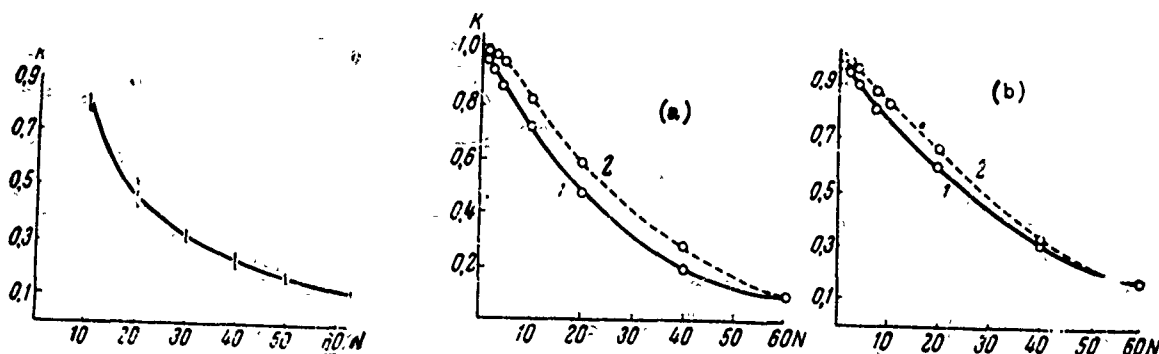


Fig. 1. Reproducibility of the results obtained on the Khandeberg instrument; Isopanchrome type 15 aerial film, developer No. 1.

Fig. 2. Results of the transfer functions of calculations on the contact optical focusing pattern and on the optical focusing pattern for projection printing. Isopanchrome type 15 aerial film: a - developer No. 1, 1 - FCC on the contact optical focusing pattern, $\gamma = 1.45$, $D_0 = 0.12$; 2 - FCC on the optical focusing pattern for projection, $\gamma = 1.32$, $D_0 = 0.11$; b - developer D-76, 1 - FCC on the contact optical focusing pattern, $\gamma = 1.00$, $D_0 = 0.20$; 2 - FCC on the optical focusing pattern for projection, $\gamma = 1.20$, $D_0 = 0.20$.

All the serially made types of black and white aerial films were tested. The transfer functions of certain Orvo films, for which there is published material [7], were derived for comparison.

Exposure on the Khandeberg device was made at a color temperature of 6500°K. A shutter speed was selected for each frequency so that the maximum and minimum densities of the sinusoidal image would correspond to the rectilinear portion of the performance curve. In order to eliminate the effect of the adjacent point, development was done with a brush. Two developers which in principle differ in the nature of development were used: No. 1, per GOST 10691-63, and D-76. A NIKFI test object was exposed at the same color temperature to obtain diffusigrams. Development was done at approximately the same magnitude of γ , up to which sinusoidal images were developed. Diffusigrams were obtained by the usual means [6]. Conversion to frequency characteristics was done in accordance with work [8].

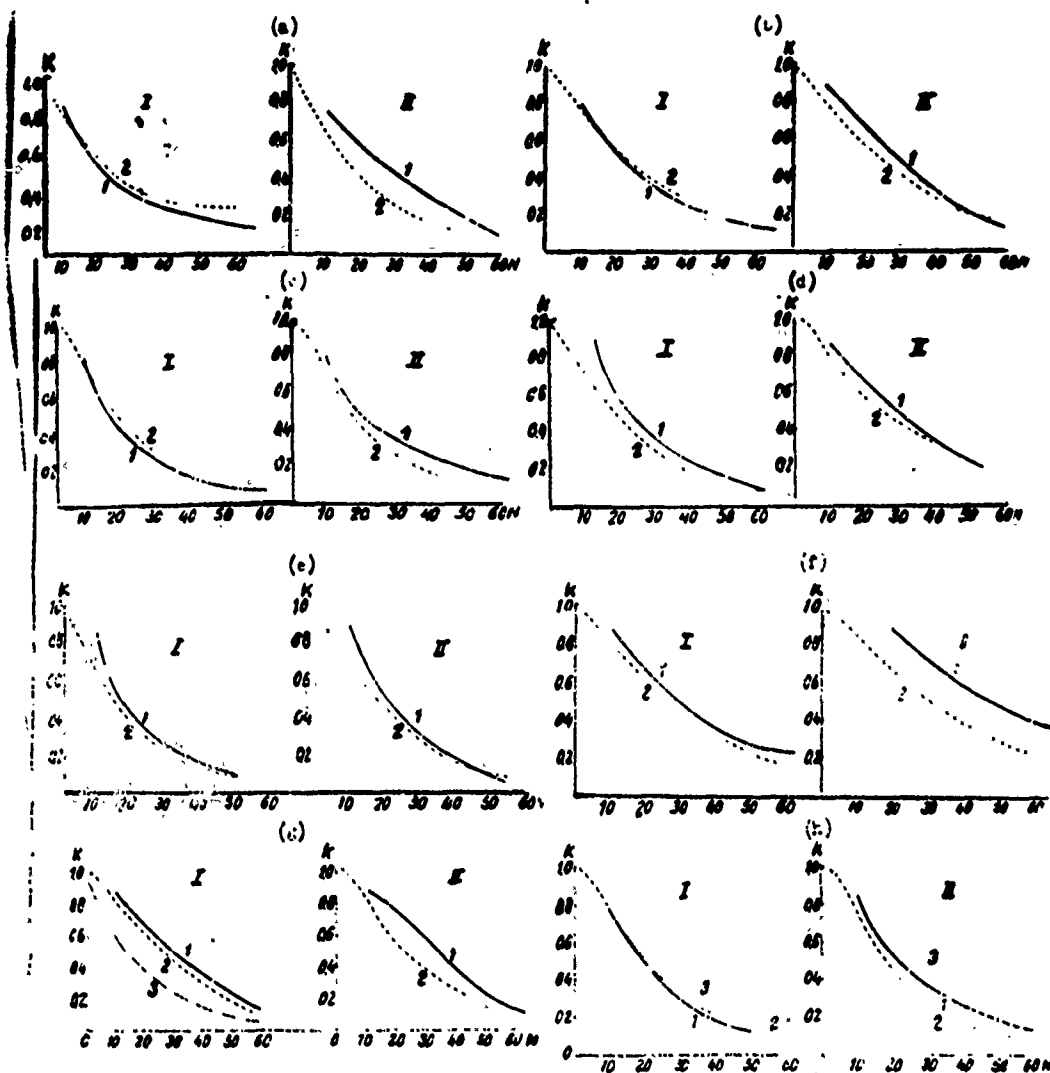


Fig. 3. Film transfer functions obtained on the Khandeberg instrument (1) and calculated by diffusigrams (2) with development by developer No. 1 (I) and developer D-76 (II): a) Panchrome type 10; developer No. 1: γ - 1.16 (1) and 1.20 (2); D-76: γ - 1.07 (1) and 1.36 (2). b) Isopanchrome type 13; developer No. 1: γ - 1.40 (1) and 1.46 (2); D-76: γ - 1.06 (1) and 1.26 (2). c) Isochrome AC-1, developer No. 1: γ - 1.20 (1) and 1.36 (2); D-76: γ - 1.15 (1) and 1.12 (2). d) Isopanchrome type 15; developer No. 1: γ - 1.51 (1) and 1.45 (2); D-76: γ - 1.30 (1) and 1.30 (2). e) Isopanchrome type 17; developer No. 1: γ - 1.56 (1) and 1.22 (2); D-76: γ - 1.22 (1) and 1.40 (2). f) Isopanchrome No. 18; developer No. 1: γ - 2.34 (1) and 2.60 (2); D-76: γ - 2.62 (1) and 2.48 (2). g) Isopanchrome type 20; developer No. 1: γ - 1.58 (1) and 1.54 (2) and 1.72 (3) - without an antihalo layer); D-76: γ - 1.40 (1) and 1.42 (2). h) Orvo NP-22; developer No. 1: γ - 1.34 (1), 1.06 (2) and published (3); Orva NP-27; developer No. 1: γ - 0.86 (1), 0.73 (2) and published (3).

Density measurements, including also that of the sensitogram, were made on an MF-2 microphotometer adapted for measuring small areas. The size of the aperture was $1.5 \times 600\mu$.

Figure 1 and the table present the reproducibility of the results obtained on the Khandeberg device. With identical values of γ , the convergence is completely satisfactory.

(1) N/mm	EXPERIMENT (2)		
	1	2	3
10	0.77	0.87	0.82
20	0.43	0.53	0.42
30	0.34	0.31	0.30
40	0.25	0.22	0.21
50	0.19	0.19	0.16
66	0.11	0.11	0.13
γ	1.37	1.23	1.23

KEY: (1) N/mm; (2) Experiment No.

To check the reliability of the calculations of the transfer function for the diffusigrams, the results obtained on a contact focusing chart and on a focusing chart used for projection printing were compared [9]. The corresponding curves are given on Fig. 2, from which it follows that the convergence is satisfactory. Figure 3 gives the transfer functions for all the tested films. The results obtained on the Khandeberg device are shown by the solid lines and the frequency-contrast characteristics calculated on the diffusigrams are given by the dashes. By comparing these drawings it is possible to ascertain that the curves determined on the Khandeberg device are always situated higher than those obtained by the calculating method, which is found in accordance with work [7]. The exception is coarse-grained, thick-emulsion films developed in an energetic developer. Both curves practically coincide for them. The correspondence can be explained by the almost complete diffusion by the emulsion layer of light

not absorbed by the light-sensitive crystals. In this case the formula proposed in [8] matches up well to the physical processes which take place in the emulsion layer. Divergence of the curves is noticeable most of all at low frequencies. At high frequencies they most often converge. Since the analyst is usually interested in the transfer of the latter, it is possible to consider that both testing methods in this respect render satisfactorily convergent results. However, in isolated cases for film greatly differing in structure (for example, for type 18 film), deviations are noticeable. Therefore, considering the higher values of the transfer function determined on the device and the great diversity in the structure of light-sensitive materials, this method should be given preference.

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